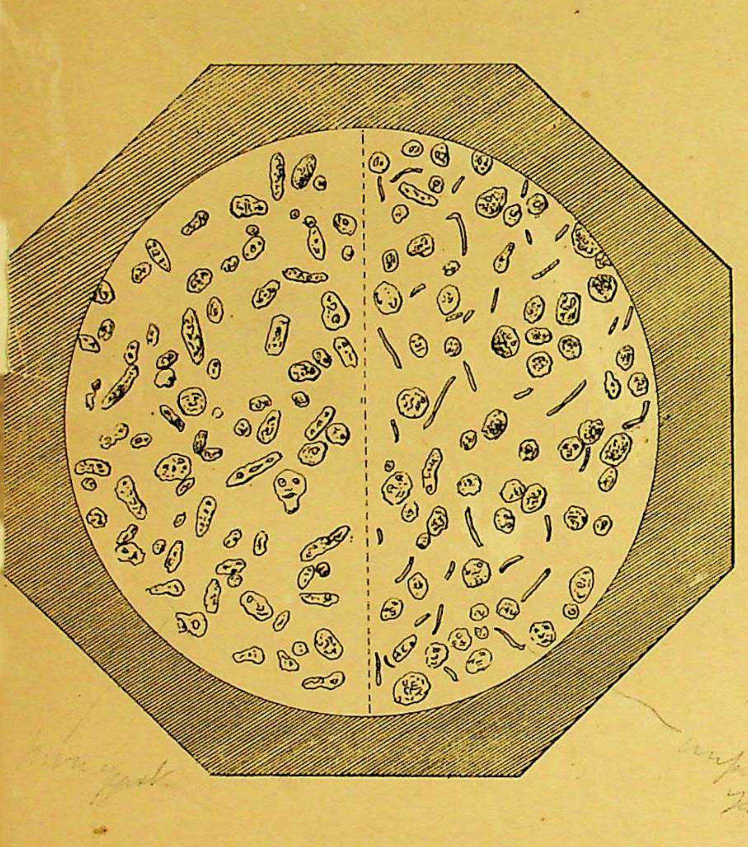
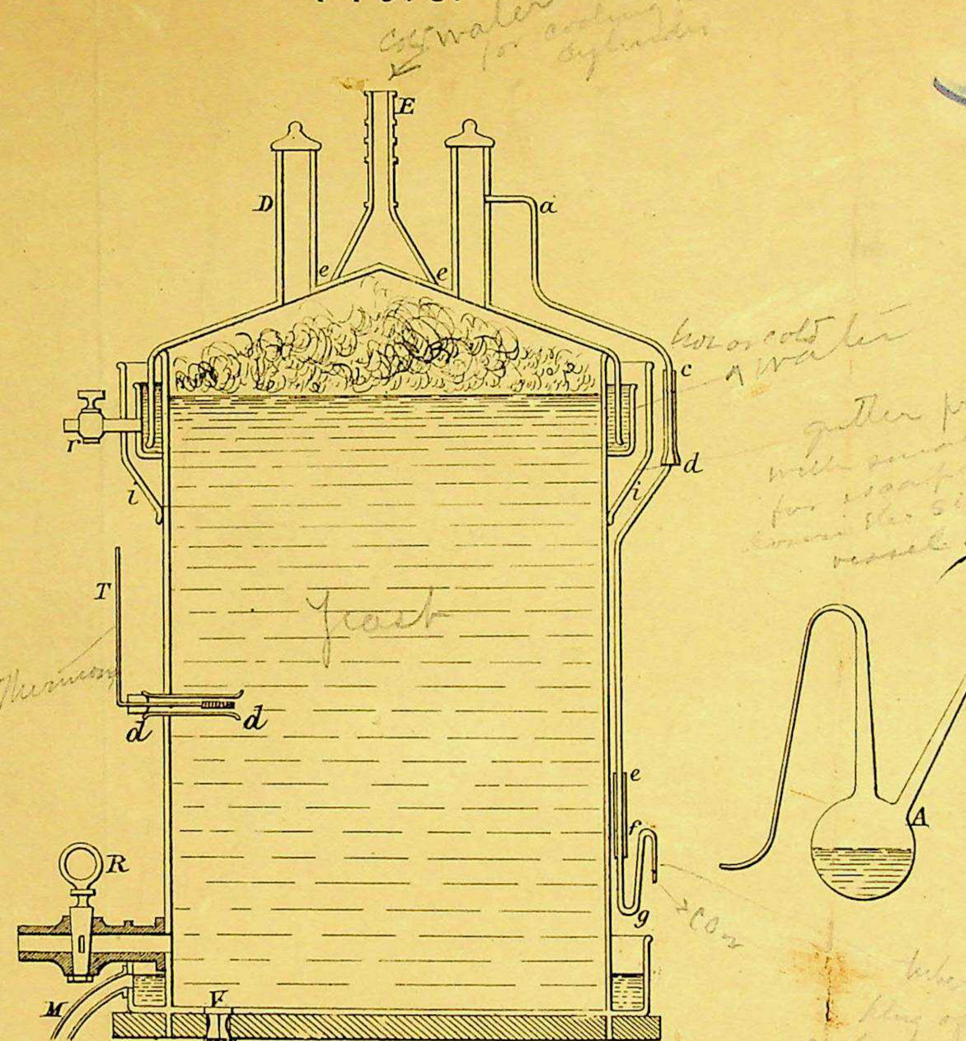
A.D. 1873. MAR. 25. Nº. 1 06
CLARK'S PROVISIONAL SPECIFICATION

Preserving Beef

F I G. I.



F I G. 3.


E
D
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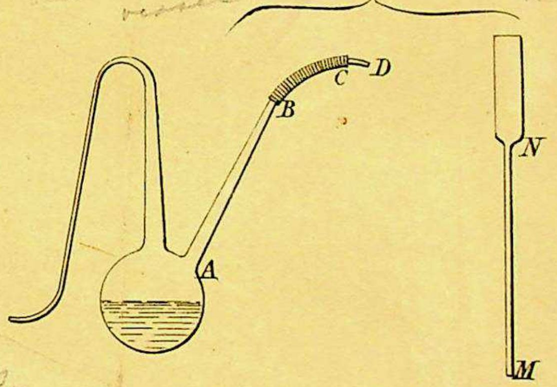
F
cold water for cooling the cylinder
hot or cold water
gutter provided with small holes for escape of water down the side of the vessel.
Yeast
Thermometer
CO2

F I G. 2.



tube closes with plug of ... or by a metal ... heated during ... of air

fruit contains a drop of liquid

1106
1873

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Drawn on Stone by Malby & Son

LONDON Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE
Printers to the Queen's most Excellent Majesty 1873

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A.D. 1873, 25*th* March. N° 1106.

# Manufacture and Preservation of Beer, &c.

**LETTERS PATENT** to Alexander Melville Clark, of 53, Chancery Lane, in the County of Middlesex, Patent Agent, for the Invention of "Improvements in the Manufacture and Preservation of Beer, and in the Treatment of Yeast and Wort, together with Apparatus for the same."—A communication from abroad by Louis Pasteur, of Paris, France, Chemist, Member of the Institute.

Sealed the 9th September 1873, and dated the 25th March 1873.

**PROVISIONAL SPECIFICATION** left by the said Alexander Melville Clark at the Office of the Commissioners of Patents, with his Petition, on the 25th March 1873.

I, Alexander Melville Clark, of 53, Chancery Lane, in the County of Middlesex, Patent Agent, do hereby declare the nature of the said Invention for "Improvements in the Manufacture and Preservation of Beer, and in the Treatment of Yeast and Wort, together with Apparatus for the same," to be as follows:—

The variations in the condition of brewers' yeast, worts, and beer are caused by the presence of microscopic organisms, the development and multiplication of which are accompanied by the formation of substances which change the properties of the wort, beer, or yeast, and also prevent their keeping beyond a certain time. These organisms exist in varying proportions in cooled worts as prepared by the ordinary processes, as well as in yeast and beer.

The object of this Invention is to eliminate and prevent the multiplication of these organisms by the following means, viz. :—

1st. Obtaining pure yeast by separating the organic germs foreign to brewers' yeast.

2ndly. Treating the wort while cooling from the time it leaves the copper in which all the germs (germs de maladie) are destroyed, until it reaches the vats, tuns, or fermenting apparatus, and even after fermentation, in such manner that it shall not again receive either by unlimited contact with the open air, or with the vessels employed, any pernicious germs capable of multiplying and of subsequently changing the nature of the products.

3rdly. Cooling in closed vessels in the presence of a limited supply of filtered air or carbonic acid gas.

Pure yeast, free from pernicious germs, may be obtained in various ways, among which I will indicate the following :—I take impure yeast, and cause it to act on a solution of sugar candy in pure water. When the fermentation is terminated I decant the fermented liquid, and add a fresh quantity of sugared water on the top of the yeast deposit. This operation is repeated two or three times, more or less, according to circumstances. I then take a shallow porcelain dish, first dipping it in boiling water, and put in it a little beer wort which has been recently boiled or preserved by the Appert process. I then dilute a little of the yeast deposit of the above described fermentation in the wort and cover it with a glass plate. The yeast which has become more or less exhausted by its action on the sugared water will then rise and rapidly revive, purified of its pernicious germs (ferments de maladie). This treatment may be repeated by diluting a little of the yeast deposited at the bottom of the first dish in some fresh wort. The degree of purity of the yeast may be ascertained with the aid of a microscope, which will indicate the presence of the germs, and show whether, by means of the yeast, a beer may be produced which shall not vary in condition at any temperature.

(In the diagram Figure 1 of the accompanying Drawing the left half of the Figure shows a pure alcoholic yeast, and the other half an alcoholic yeast containing the pernicious germs, (which are filiform in appearance). For this purpose I take a balloon of the form shown in Figure 2 of any suitable dimensions, and about half fill it with beer wort which is first rendered unalterable by being boiled in the balloon itself. The neck A, B, is closed by an india-rubber tube *b*, *c*, and a glass plug C, D. The plug is removed, and one or more drops of the yeast from the dish diluted with a little of the supernatant liquid is introduced by means of the tube M, N, which ferments the wort, and transforms it into beer. If this beer, after remaining some weeks in a stove having a temperature of from 70 to 80 degrees Fahrenheit, be examined under the microscope and no such germs can be perceived, it will show that the small quantity of yeast introduced was perfectly free therefrom. With yeast thus obtained large quantities may be prepared, it being generated during the manufacture of the beer itself. The yeast may also be preserved indefinitely in a pure state in contact with pure air, that is to say, purged of all germs liable to affect the condition of the yeast, either in an apparatus such as that shown in Figure 2, or other similar arrangement. It may also be carried long distances without affecting its condition, and so serve for preparing pure yeast at all seasons, and in any quantity desired. By this means the brewer will be spared the necessity of obtaining a fresh supply of yeast from a brewery when his own has become deteriorated, inasmuch as he has always yeast at his disposal in an ever pure condition.

The alcoholic yeasts which are properly distinct may also be propogated and increased without alteration by the aid of the apparatus shown in Figure 2.

I will next describe the improved process of manufacturing and preserving beer and preparing yeast exempt from the germs on any desired scale.

I use the apparatus, Figure 3, composed of a hollow cylinder closed by a cover, the rim of which dips into a water channel around the top of the cylinder provided with a cock *r*. The beer wort, properly so called, or other wort used in beer making is first boiled in the copper and then poured into the cylinder, which is completely filled, and the cover put on. Then by means of a rubber tube *c*, *d*, the metal pipe *a*, *c*, (opening into a stoppered pipe rising from the cover) is connected with the tube *d*, *e*, *f*, *g*. Boiling water is then poured on the cover and on the pipes rising therefrom, which fills the channel, the overflow passing into a gutter *i*, *i*, from which the water escapes through a slit or a number of small holes in the bottom, and is collected in another gutter at bottom of the cylinder provided with a discharge pipe M. T is a bent thermometer for indicating the temperature of the wort, the bulb of which is protected by a perforated guard *d*, *d*. R, V, cocks or apertures for discharging the liquid and sediment from the cylinder. The cylinder thus filled is allowed to cool by contact of the external air, afterwards assisted if necessary by cold water introduced at the pipe E on the cover which passes through apertures *e*, *e*, and trickles down over the cylinder. Air enters the long tube *g*, *e*, *f*, *d*, *c*, *a*. The yeast is then introduced through the pipe D, which is immediately closed, the carbonic acid produced during the fermentation passing off at tube *f*, *g*. A tube similar to *a*, *c*, *d*, *e*, *f*, *g*, may be adapted to pipe D, of a different length if desired, for the escape of the carbonic acid gas, whilst a limited quantity of air is admitted by the other tube. The wort may be readily cooled in the presence of the carbonic acid gas by introducing the latter beneath the cover during the cooling. The tube *f*, *g*, may terminate by a loose plug of asbestos or cotton or by a metal tube heated during the admission of the air. A drop of liquid in bend *g* will serve to indicate the movements of the gases.

The apparatus may be greatly varied in form and any apparatus which will serve to eliminate the pernicious germs derived either from the air, the raw materials, the yeast, or the apparatus itself, will answer the purpose.

The employment of pure yeast in the above process is of prime necessity, that is to say, yeast deprived of the germs by which the beer is liable to be affected. All kinds of beer manufactured by this process may be preserved without the aid of ice, and may be made in hot as well as cold climates, in summer as in winter. As there is no liability of the worts undergoing any change a very small quantity only of pure yeast will be sufficient to ferment it.

The following is a recapitulation of the essential features of this improved process :—The wort is introduced in a boiling state into the apparatus, on which a cover is then placed, or the cylinder may be entirely closed and communicate with the atmosphere only by means of the pipes, cocks, and long tubes, with which it is provided. Boiling water is then thrown on the apparatus, after which it is allowed to cool with or without the assistance of cold water, during which time air or carbonic acid gas is admitted by the long tube *g*, *d*, *e*, *f*, *c*, *a*; but previous to this one of the pipes on the cover is closed by a plug through which passes a tube terminating in an india-rubber tube and glass stopper. Pure wort is then fermented by pure yeast, and when sufficiently advanced the contents are poured through the tube in the stopper of the pipe on the cover of the fermenting apparatus. If there is a supply of pure yeast from the preceding operation this may be used as in the ordinary processes, the vessel being uncovered for the purpose if necessary after fermentation has commenced; but this might lead to great inconvenience at a subsequent period, although the use of pure yeast manufactured according to this improved process would of itself form a great improvement on the ordinary processes.

With the aid of the microscope and the method of control before indicated the changes of condition which might arise under the latter modes of treatment may be readily ascertained. But one cooling apparatus may be used or a few only, the wort being passed into vats (pitched or varnished on the exterior) which are deprived of any of the before mentioned germs, either by the use of boiling water or by a recent coating of pitch on the interior. It will be seen that the ordinary processes and the improved method may if desired be carried on simultaneously, so that brewers will be enabled to gradually transform their plant.

After the beer is made any short exposure to the air to which it may be subjected will have little or no prejudicial effect on its keeping qualities, and it may also be fined in the usual way.

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SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Alexander Melville Clark in the Great Seal Patent Office on the 24th September 1873.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, ALEXANDER MELVILLE CLARK, of 53, Chancery Lane, in the County of Middlesex, Patent Agent, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-fifth day of March, in the year of our Lord One thousand eight hundred and seventy-three, in the thirty-sixth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Alexander Melville Clark, Her special licence that I, the said Alexander Melville Clark, my executors, administrators, and assigns, or such others as I, the said Alexander Melville Clark, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN THE MANUFACTURE AND PRESERVATION OF BEER, AND IN THE TREATMENT OF YEAST AND WORT, TOGETHER WITH APPARATUS FOR THE SAME," a communication to me from abroad by Louis Pasteur, of Paris, France, Chemist, Member of the Institute, upon the condition (amongst others) that I, the said Alexander Melville Clark, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Alexander Melville Clark, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the Sheet of Drawings hereunto annexed, and to the letters and figures marked thereon (that is to say) :—

The changes which take place in the yeasts of beer, in worts, and also in beer itself, are due to the presence of microscopic organisms, whose developements and multiplication are accompanied by the formation of substances which alter the nature of the worts, beer, or yeasts, and which in any case tend to prevent the beer remaining sound beyond a certain length of time. These organisms are what I term "disease ferments" or germs of disease, they exist in varying proportions in all worts prepared and cooled by the methods at present in use as well as in the yeasts and consequently in all the different kinds of beer.

The object of this Invention is to suppress in these three products, yeast, worts, and beer, the existence and mltiplication of these extraneous ferments or germs by the following means:—

1st. By obtaining a pure yeast by the elimination of organic germs foreign to the yeast of beer.

2nd. By the manipulation of the wort during cooling, from the time of its leaving the copper, where all the "disease germs" are killed, until it reaches the squares, rounds, or other fermenting apparatus, and even after fermentation in such manner that it cannot take up, through coming into unrestricted contact with the atmosphere or with the utensils, any pernicious germs capable of multiplying themselves and ultimately of depreciating the product.

3rd. By cooling in closed vessels in the presence of a limited amount of purified air or of carbonic acid gas.

This new product which I have called "pure leaven" (levain pur), or yeast freed from extraneous germs may be obtained by various methods among which I will indicate the following:—I take some impure (ordinary) yeast and set it to work on a solution of sugar candy in pure water. When the fermentation has ceased I decant the fermented liquid, and on the deposit of yeast replace a fresh supply of the sugared water. This operation is repeated two or three times more or less according to circumstances. I then take a shallow porcelain tray, such as is used by photographers, and having previously rinsed it in boiling water I put in this tray a little beer wort, either recently boiled or preserved in bottles according to Appert's method, then with this wort I incorporate (by beating up) a little of the deposited yeast referred to and cover it with a glass plate. The yeast more or less exhausted or weakened by its action on the sugared water will now rapidly develop and revivify itself, and will be found to be purified of its "disease ferments." The operation with the porcelain tray may be repeated with a second tray, beating up in fresh beer wort placed in it a little of the yeast formed on the bottom of the preceding tray. In order to be satisfied of the purity of the yeast recourse may be had to microscopical examination, which will readily disclose the presence of "disease ferments" and indicate whether or not the yeast is capable of producing beer unalterable at all temperatures.

Figure 1 of the Drawing represents on the left-hand side the appearance of pure alcoholic yeast, and on the right-hand side an alcoholic yeast in combination with filiform "disease ferments." To make this investigation I take a balloon or receiver of the form shown in Figure 2, of any suitable dimensions, and half fill it or thereabouts with beer wort which has been rendered inalterable by boiling in the balloon itself. The neck A, B, of the receiver is closed by an india-rubber tube B, C, with a glass stopper D. The glass stopper is removed and with the tube M, N, one or more drops of the yeast from the porcelain tray shaken or beaten up with a little of the supernatant liquid are introduced into the apparatus. This yeast multiplies itself, the wort ferments, and becomes transformed into beer. If this beer when examined under the microscope, after remaining for some weeks exposed to a temperature of from 68 to 77° Fahrenheit, shows no trace of the "disease ferments" it is evident that the small quantity of yeast introduced into the balloon was itself perfectly free from such ferments. From the "leaven" or yeast so obtained as large a quantity as may be required can be prepared, the yeast reproducing itself even in the manufacture of the beer. It may also be indefinitely preserved in absolute purity in contact with pure air, that is to say, of air purged of the germs liable to affect the condition of the yeast by the aid of the apparatus shown in Figure 2, or of any other vessel fulfilling the same requirements. It may also be transported any distance without undergoing alteration, and thenceforth from the same source such yeast may be prepared at all seasons in as large a quantity as may be desired. This is a great step in the art of brewing, since it exempts the brewer from the necessity of having recourse to the yeast of other breweries more or less remote when his own becomes deteriorated, and places at his disposal one that is pure and unalterable.

Alcoholic yeasts, really distinct in their nature from other yeasts, may be "sown" or disseminated and cultivated without alteration of their properties by the employment of vessels similar to that indicated in Figure 2.

I will now proceed to describe the improved process for the manufacture and conservation of beer, and the preparation of yeast entirely free from disease germs on any desired scale.

I employ the apparatus shown in Figure 3, constructed either of sheet iron or tinned copper. It consists of a cylindrical vessel closed at the top by a cover, the rim of which projects downwards into a channel around the top of the vessel filled with water, and provided with a cock *r*. The beer wort, properly so called, or any other wort suitable for the manufacture of beer, is first boiled in the copper, and in this condition is conducted into the cylinder, which may be completely filled, and the lid is then put on; then by means of the india-rubber tube *c*, *d*, the metal pipe *a*, *c*, (opening into a stoppered pipe or socket rising from the cover) is connected with the tube *d*, *e*, *f*, *g*. Boiling water is then poured over the lid and socket pipes and their stoppers, filling the channel, the overflow passing into a gutter *i*, *i*, from which the water escapes through a slit or a number of small holes, and flows down outside the vessel, and is collected in a lower gutter provided with a discharge pipe at M. T is a bent thermometer to indicate the temperature of the wort, its bulb being protected by a perforated guard *d*, *d*; R, V, are cocks or valves for the discharge of the liquid from the cylinder, and the deposit formed in it. I leave the apparatus thus filled to become cooled by contact with the external air, aided afterwards, if thought expedient or useful, by the application of cold water introduced at the larger pipe E on the cover, which is allowed to flow through apertures at *e*, *e*, and trickles down over the vessel. The external air enters through the long tube *g*, *f*, *e*, *d*, *c*, *a*, during the whole of the period occupied in cooling, and when that is accomplished the yeast is introduced through the pipe D, which is at once closed, the carbonic acid gas disengaged during the fermentation passing off through the tube *f*, *g*. A tube similar to the tube *a*, *b*, *c*, *d*, *e*, *f*, *g*, may be adapted to the socket pipe D, if desired, of a different length to admit of the escape of the carbonic acid gas, whilst a limited quantity of air is admitted by the other tube. The wort also may readily be cooled in the presence of carbonic acid gas by causing the gas to be introduced beneath the cover during the refrigeration. The tube *f*, *g*, may end with a loose plug or stopper of asbestos, cotton, or by a metallic tube, made hot during the admission of the air. A small quantity of liquid in the bend *g* will serve to indicate the movement of the gas.

The form of this apparatus may be varied considerably, but any apparatus which will serve to eliminate the germs of disease imparted by the atmosphere, by the raw materials, by the yeast, or by the utensils will answer the purpose. This process imperatively demands the employment of a yeast absolutely pure, that is to say, deprived of those germs of disease by which beer is liable to be affected. Any beers made by this process may be preserved without the employment of ice, and may be manufactured with as much facility in hot countries as in cold, in summer as well as in winter. As no alternation is to be feared in the wort a very small quantity only of the pure yeast will be sufficient to ferment it.

The following is a recapitulation of the successive steps essential to this process:—The wort is introduced in a boiling state into the apparatus, on which a cover is then placed, or the cylinder may be entirely closed, and communication with the atmosphere need only take place by means of the socket pipes, the cocks, or the long tubes with which it is provided. Boiling water is then thrown over the apparatus, as previously described, after which it is allowed to cool, either with or without the application of cold water, whilst through the long tube *g*, *d*, *e*, *f*, *c*, *a*, air or carbonic acid gas is admitted, one of the socket pipes on the cover having been previously closed by a stopper through which passes a tube terminating in an india-rubber tube having a glass stopper. Some pure beer wort is also set to ferment with pure yeast, and when the fermentation is fairly established or more or less accomplished, the contents are poured through the tube, which passes through the stopper of the socket pipe on the cover of the apparatus.

If the brewer has already some pure yeast from a previous operation, it can be used exactly as in the ordinary manner, uncovering the vat if necessary, after the fermentation has begun, though this mode of procedure may possibly lead to grave ulterior disadvantages. Nevertheless, it would have the effect of greatly improving the existing method of working if this new process were employed only so far as the use of pure yeast is concerned.

By the microscope and the means of control I have previously indicated the alterations which may or can ensue upon the employment of these last methods of working may be readily ascertained.

Only one refrigerator or cooler is absolutely necessary, or at most a few coolers only, the wort being passed into vats or casks which have been deprived of the germs of disease, either by the application of boiling water (the pitching or varnishing being external), or by the recent pitching of the interior.)

It will be seen that the existing process of brewing and this new method may be carried on simultaneously in a manner that will enable brewers to gradually alter and transform their plant and utensils as circumstances may permit.

When the beer is made, neither its exposure to the air during a more or less extended manipulation, nor fining under the ordinary system will have little or any prejudicial effect on its ulterior keeping qualities.

Having described the nature of the said Invention, and the manner in which the same is to be performed, I declare that what I claim as the Invention to be protected by the herein-before in part recited Letters Patent is,—

1st. The adaptation to brewing of the following combination of processes, methods, or means, and each of them specially, viz., the obtaining of a pure leaven or yeast by the elimination of the organic germs foreign to the yeast of beer; the methodic and special manner of manipulation of the wort during cooling from the time of its leaving the copper (in which all the germs of disease are destroyed), to the vessels in which fermentation is induced, in such manner that it cannot become reimpregnated with pernicious germs derived from unlimited contact with the air or of the utensils employed; the cooling in a closed vessel in presence of carbonic acid gas, or in presence of air purified and limited in quantity, all substantially as herein described.

2nd. The apparatus or means by which these processes entirely or partially may be carried out in practice, substantially as specified.

3rd. The obtention by these processes and means of the improved products herein specified, viz., beer unalterable in character, pure yeast, or pure wort, substantially as described; all three products being capable of transport to any distance without alteration or deterioration.

In witness whereof, I, the said Alexander Melville Clark, have hereunto set my hand and seal, this Twenty-fourth day of September, in the year of our Lord One thousand eight hundred and seventy-three.

A. M. CLARK. (L.S.)

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LONDON:
Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1873.

(1 SHEET)

A.D. 1873. MAR. 25. N° 1106.
CLARK'S SPECIFICATION.

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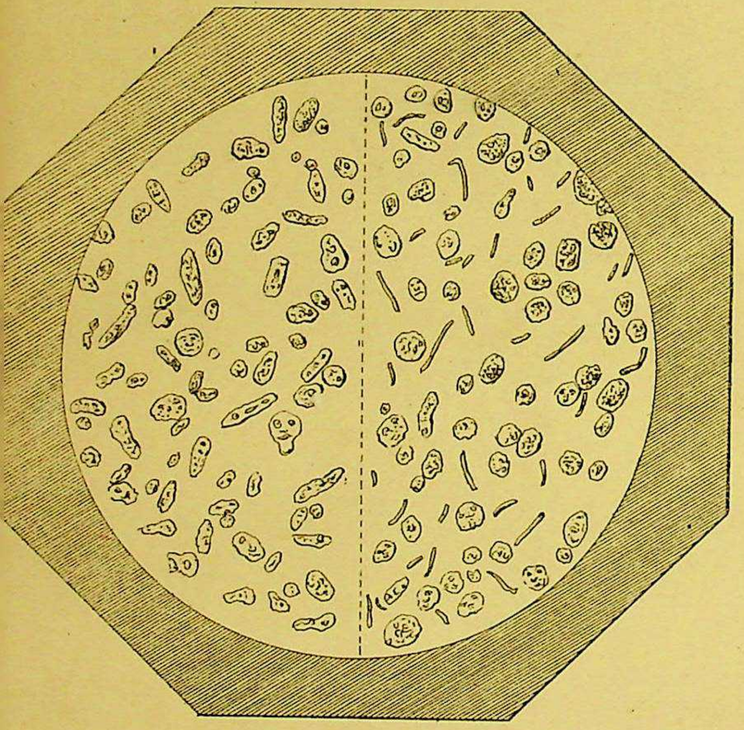
F I G. 1.



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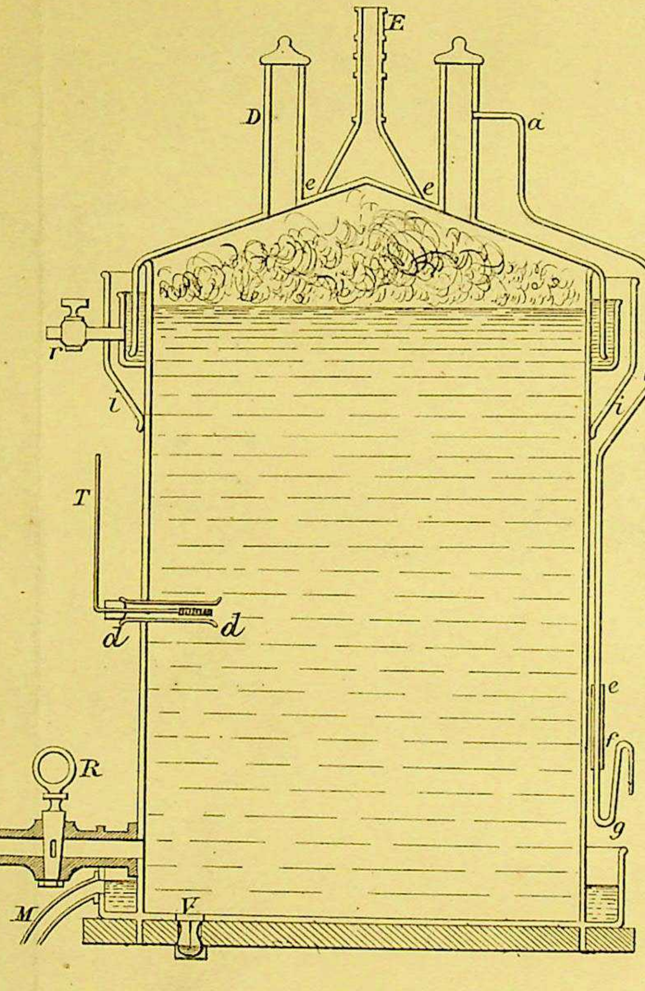

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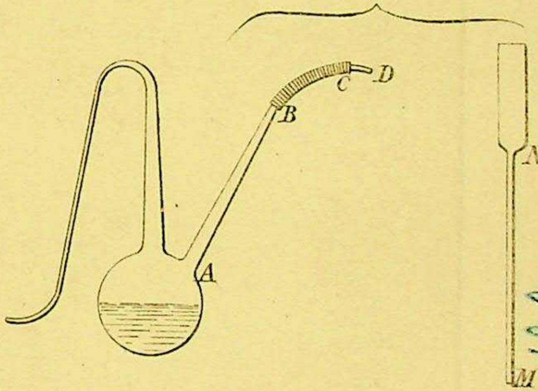

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of the pipes, cocks, and long tubes, with which it is provided. Boiling water is then thrown on the apparatus, after which it is allowed to cool with or without the assistance of cold water, during which time air or carbonic acid gas is admitted by the long tube *g*, *d*, *e*, *f*, *c*, *a*; but previous to this one of the pipes on the cover is closed by a plug through which passes a tube terminating in an india-rubber tube and glass stopper. Pure wort is then fermented by pure yeast, and when sufficiently advanced the contents are poured through the tube in the stopper of the pipe on the cover of the fermenting apparatus. If there is a supply of pure yeast from the preceding operation this may be used as in the ordinary processes, the vessel being uncovered for the purpose if necessary after fermentation has commenced; but this might lead to great inconvenience at a subsequent period, although the use of pure yeast manufactured according to this improved process would of itself form a great improvement on the ordinary processes.

With the aid of the microscope and the method of control before indicated the changes of condition which might arise under the latter modes of treatment may be readily ascertained. But one cooling apparatus may be used or a few only, the wort being passed into vats (pitched or varnished on the exterior) which are deprived of any of the before mentioned germs, either by the use of boiling water or by a recent coating of pitch on the interior. It will be seen that the ordinary processes and the improved method may if desired be carried on simultaneously, so that brewers will be enabled to gradually transform their plant.

After the beer is made any short exposure to the air to which it may be subjected will have little or no prejudicial effect on its keeping qualities, and it may also be fined in the usual way.

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**SPECIFICATION** in pursuance of the conditions of the Letters Patent, filed by the said Alexander Melville Clark in the Great Seal Patent Office on the 24th September 1873.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, ALEXANDER MELVILLE CLARK, of 53, Chancery Lane, in the County of Middlesex, Patent Agent, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-fifth day of March, in the year of our Lord One thousand eight hundred and seventy-three, in the thirty-sixth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Alexander Melville Clark, Her special licence that I, the said Alexander Melville Clark, my executors, administrators, and assigns, or such others as I, the said Alexander Melville Clark, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN THE MANUFACTURE AND PRESERVATION OF BEER, AND IN THE TREATMENT OF YEAST AND WORT, TOGETHER WITH APPARATUS FOR THE SAME," a communication to me from abroad by Louis Pasteur, of Paris, France, Chemist, Member of the Institute, upon the condition (amongst others) that I, the said Alexander Melville Clark, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Alexander Melville Clark, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the Sheet of Drawings hereunto annexed, and to the letters and figures marked thereon (that is to say):—

The changes which take place in the yeasts of beer, in worts, and also in beer itself, are due to the presence of microscopic organisms, whose developements and multiplication are accompanied by the formation of substances which alter the nature of the worts, beer, or yeasts, and which in any case tend to prevent the beer remaining sound beyond a certain length of time. These organisms are what I term "disease ferments" or germs of disease, they exist in varying proportions in all worts prepared and cooled by the methods at present in use as well as in the yeasts and consequently in all the different kinds of beer.

The object of this Invention is to suppress in these three products, yeast, worts, and beer, the existence and mltiplication of these extraneous ferments or germs by the following means:—

1st. By obtaining a pure yeast by the elimination of organic germs foreign to the yeast of beer.

2nd. By the manipulation of the wort during cooling, from the time of its leaving the copper, where all the "disease germs" are killed, until it reaches the squares, rounds, or other fermenting apparatus, and even after fermentation in such manner that it cannot take up, through coming into unrestricted contact with the atmosphere or with the utensils, any pernicious germs capable of multiplying themselves and ultimately of depreciating the product.

3rd. By cooling in closed vessels in the presence of a limited amount of purified air or of carbonic acid gas.

This new product which I have called "pure leaven" (levain pur), or yeast freed from extraneous germs may be obtained by various methods among which I will indicate the following:—I take some impure (ordinary) yeast and set it to work on a solution of sugar candy in pure water. When the fermentation has ceased I decant the fermented liquid, and on the deposit of yeast replace a fresh supply of the sugared water. This operation is repeated two or three times more or less according to circumstances. I then take a shallow porcelain tray, such as is used by photographers, and having previously rinsed it in boiling water I put in this tray a little beer wort, either recently boiled or preserved in bottles according to Appert's method, then with this wort I incorporate (by beating up) a little of the deposited yeast referred to and cover it with a glass plate. The yeast more or less exhausted or weakened by its action on the sugared water will now rapidly develop and revivify itself, and will be found to be purified of its "disease ferments." The operation with the porcelain tray may be repeated with a second tray, beating up in fresh beer wort placed in it a little of the yeast formed on the bottom of the preceding tray. In order to be satisfied of the purity of the yeast recourse may be had to microscopical examination, which will readily disclose the presence of "disease ferments" and indicate whether or not the yeast is capable of producing beer unalterable at all temperatures.

Figure 1 of the Drawing represents on the left-hand side the appearance of pure alcoholic yeast, and on the right-hand side an alcoholic yeast in combination with filiform "disease ferments." To make this investigation I take a balloon or receiver of the form shown in Figure 2, of any suitable dimensions, and half fill it or thereabouts with beer wort which has been rendered inalterable by boiling in the balloon itself. The neck A, B, of the receiver is closed by an india-rubber tube B, C, with a glass stopper D. The glass stopper is removed and with the tube M, N, one or more drops of the yeast from the porcelain tray shaken or beaten up with a little of the supernatant liquid are introduced into the apparatus. This yeast multiplies itself, the wort ferments, and becomes transformed into beer. If this beer when examined under the microscope, after remaining for some weeks exposed to a temperature of from 68 to 77° Fahrenheit, shows no trace of the "disease ferments" it is evident that the small quantity of yeast introduced into the balloon was itself perfectly free from such ferments. From the "leaven" or yeast so obtained as large a quantity as may be required can be prepared, the yeast reproducing itself even in the manufacture of the beer. It may also be indefinitely preserved in absolute purity in contact with pure air, that is to say, of air purged of the germs liable to affect the condition of the yeast by the aid of the apparatus shown in Figure 2, or of any other vessel fulfilling the same requirements. It may also be transported any distance without undergoing alteration, and thenceforth from the same source such yeast may be prepared at all seasons in as large a quantity as may be desired. This is a great step in the art of brewing, since it exempts the brewer from the necessity of having recourse to the yeast of other breweries more or less remote when his own becomes deteriorated, and places at his disposal one that is pure and unalterable.

Alcoholic yeasts, really distinct in their nature from other yeasts, may be "sown" or disseminated and cultivated without alteration of their properties by the employment of vessels similar to that indicated in Figure 2.

I will now proceed to describe the improved process for the manufacture and conservation of beer, and the preparation of yeast entirely free from disease germs on any desired scale.

I employ the apparatus shown in Figure 3, constructed either of sheet iron or tinned copper. It consists of a cylindrical vessel closed at the top by a cover, the rim of which projects downwards into a channel around the top of the vessel filled with water, and provided with a cock *r*. The beer wort, properly so called, or any other wort suitable for the manufacture of beer, is first boiled in the copper, and in this condition is conducted into the cylinder, which may be completely filled, and the lid is then put on; then by means of the india-rubber tube *c*, *d*, the metal pipe *a*, *c*, (opening into a stoppered pipe or socket rising from the cover) is connected with the tube *d*, *e*, *f*, *g*. Boiling water is then poured over the lid and socket pipes and their stoppers, filling the channel, the overflow passing into a gutter *i*, *i*, from which the water escapes through a slit or a number of small holes, and flows down outside the vessel, and is collected in a lower gutter provided with a discharge pipe at M. T is a bent thermometer to indicate the temperature of the wort, its bulb being protected by a perforated guard *d*, *d*; R, V, are cocks or valves for the discharge of the liquid from the cylinder, and the deposit formed in it. I leave the apparatus thus filled to become cooled by contact with the external air, aided afterwards, if thought expedient or useful, by the application of cold water introduced at the larger pipe E on the cover, which is allowed to flow through apertures at *e*, *e*, and trickles down over the vessel. The external air enters through the long tube *g*, *f*, *e*, *d*, *c*, *a*, during the whole of the period occupied in cooling, and when that is accomplished the yeast is introduced through the pipe D, which is at once closed, the carbonic acid gas disengaged during the fermentation passing off through the tube *f*, *g*. A tube similar to the tube *a*, *b*, *c*, *d*, *e*, *f*, *g*, may be adapted to the socket pipe D, if desired, of a different length to admit of the escape of the carbonic acid gas, whilst a limited quantity of air is admitted by the other tube. The wort also may readily be cooled in the presence of carbonic acid gas by causing the gas to be introduced beneath the cover during the refrigeration. The tube *f*, *g*, may end with a loose plug or stopper of asbestos, cotton, or by a metallic tube, made hot during the admission of the air. A small quantity of liquid in the bend *g* will serve to indicate the movement of the gas.

The form of this apparatus may be varied considerably, but any apparatus which will serve to eliminate the germs of disease imparted by the atmosphere, by the raw materials, by the yeast, or by the utensils will answer the purpose. This process imperatively demands the employment of a yeast absolutely pure, that is to say, deprived of those germs of disease by which beer is liable to be affected. Any beers made by this process may be preserved without the employment of ice, and may be manufactured with as much facility in hot countries as in cold, in summer as well as in winter. As no alternation is to be feared in the wort a very small quantity only of the pure yeast will be sufficient to ferment it.

The following is a recapitulation of the successive steps essential to this process:—The wort is introduced in a boiling state into the apparatus, on which a cover is then placed, or the cylinder may be entirely closed, and communication with the atmosphere need only take place by means of the socket pipes, the cocks, or the long tubes with which it is provided. Boiling water is then thrown over the apparatus, as previously described, after which it is allowed to cool, either with or without the application of cold water, whilst through the long tube *g*, *d*, *e*, *f*, *c*, *a*, air or carbonic acid gas is admitted, one of the socket pipes on the cover having been previously closed by a stopper through which passes a tube terminating in an india-rubber tube having a glass stopper. Some pure beer wort is also set to ferment with pure yeast, and when the fermentation is fairly established or more or less accomplished, the contents are poured through the tube, which passes through the stopper of the socket pipe on the cover of the apparatus.

If the brewer has already some pure yeast from a previous operation, it can be used exactly as in the ordinary manner, uncovering the vat if necessary, after the fermentation has begun, though this mode of procedure may possibly lead to grave ulterior disadvantages. Nevertheless, it would have the effect of greatly improving the existing method of working if this new process were employed only so far as the use of pure yeast is concerned.

By the microscope and the means of control I have previously indicated the alterations which may or can ensue upon the employment of these last methods of working may be readily ascertained.

Only one refrigerator or cooler is absolutely necessary, or at most a few coolers only, the wort being passed into vats or casks which have been deprived of the germs of disease, either by the application of boiling water (the pitching or varnishing being external), or by the recent pitching of the interior.)

It will be seen that the existing process of brewing and this new method may be carried on simultaneously in a manner that will enable brewers to gradually alter and transform their plant and utensils as circumstances may permit.

When the beer is made, neither its exposure to the air during a more or less extended manipulation, nor fining under the ordinary system will have little or any prejudicial effect on its ulterior keeping qualities.

Having described the nature of the said Invention, and the manner in which the same is to be performed, I declare that what I claim as the Invention to be protected by the herein-before in part recited Letters Patent is,—

1st. The adaptation to brewing of the following combination of processes, methods, or means, and each of them specially, viz., the obtaining of a pure leaven or yeast by the elimination of the organic germs foreign to the yeast of beer; the methodic and special manner of manipulation of the wort during cooling from the time of its leaving the copper (in which all the germs of disease are destroyed), to the vessels in which fermentation is induced, in such manner that it cannot become reimpregnated with pernicious germs derived from unlimited contact with the air or of the utensils employed; the cooling in a closed vessel in presence of carbonic acid gas, or in presence of air purified and limited in quantity, all substantially as herein described.

2nd. The apparatus or means by which these processes entirely or partially may be carried out in practice, substantially as specified.

3rd. The obtention by these processes and means of the improved products herein specified, viz., beer unalterable in character, pure yeast, or pure wort, substantially as described; all three products being capable of transport to any distance without alteration or deterioration.

In witness whereof, I, the said Alexander Melville Clark, have hereunto set my hand and seal, this Twenty-fourth day of September, in the year of our Lord One thousand eight hundred and seventy-three.

A. M. CLARK. (L.S.)

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